NASA Space Science

An Overview

Presented at

AAS Meeting

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Space Science Enterprise
Agency Vision and Mission

The NASA Vision: "To improve life here, to extend life to there, to find life beyond."

The NASA Mission: "To understand and protect our home planet, to explore the universe and search for life, to inspire the next generation of explorers . . .
as only NASA can."

Space Science Vision

- How did the universe begin and evolve?
- How did we get here?
- Where are we going?
- Are we alone?

Space Science Themes

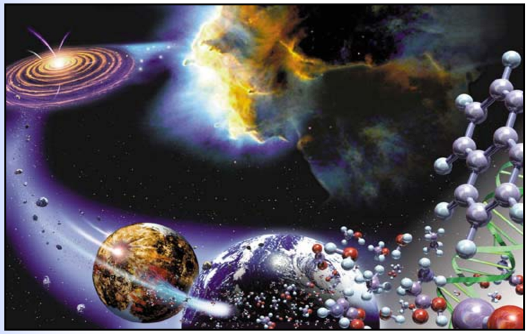
- Astronomical Search for Origins
- Structure and Evolution of the Universe
- Solar System Exploration
- Mars Exploration
- Sun Earth Connection

The Space Science Vision fully supports the NASA Mission

Space Science Enterprise
Science Themes

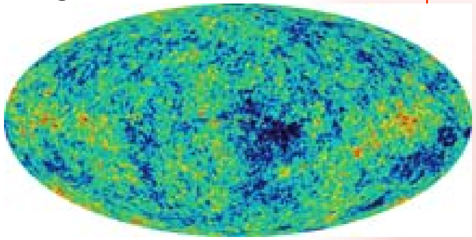
Astronomical Search for Origins

- Where Did We Come From?
- Are We Alone?



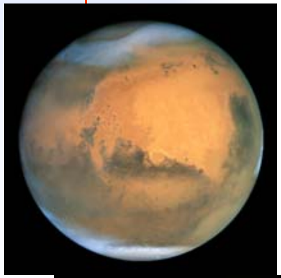
Structure and Evolution of the Universe

- What is Dark Matter that Binds Together the Universe?
- What Powered the Big Bang?
- What is the Dark Energy that Drives Apart the Universe?
- Are There Hidden Space-time Dimensions?
- What is the nature of Black Holes and Gravity Beyond Einstein?



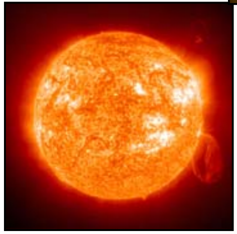
Solar System Exploration

- How do planets form?
- Why are planets different from one another?
- Where did the makings of life come from?
- Did life arise elsewhere in the Solar System?
- What is the future habitability of Earth and other planets?



Sun Earth Connection

- What causes solar variability?
- How does solar variability affect the Earth and other planets?
- How does solar variability affect life and society?
- How does the Sun interact with the interstellar medium?

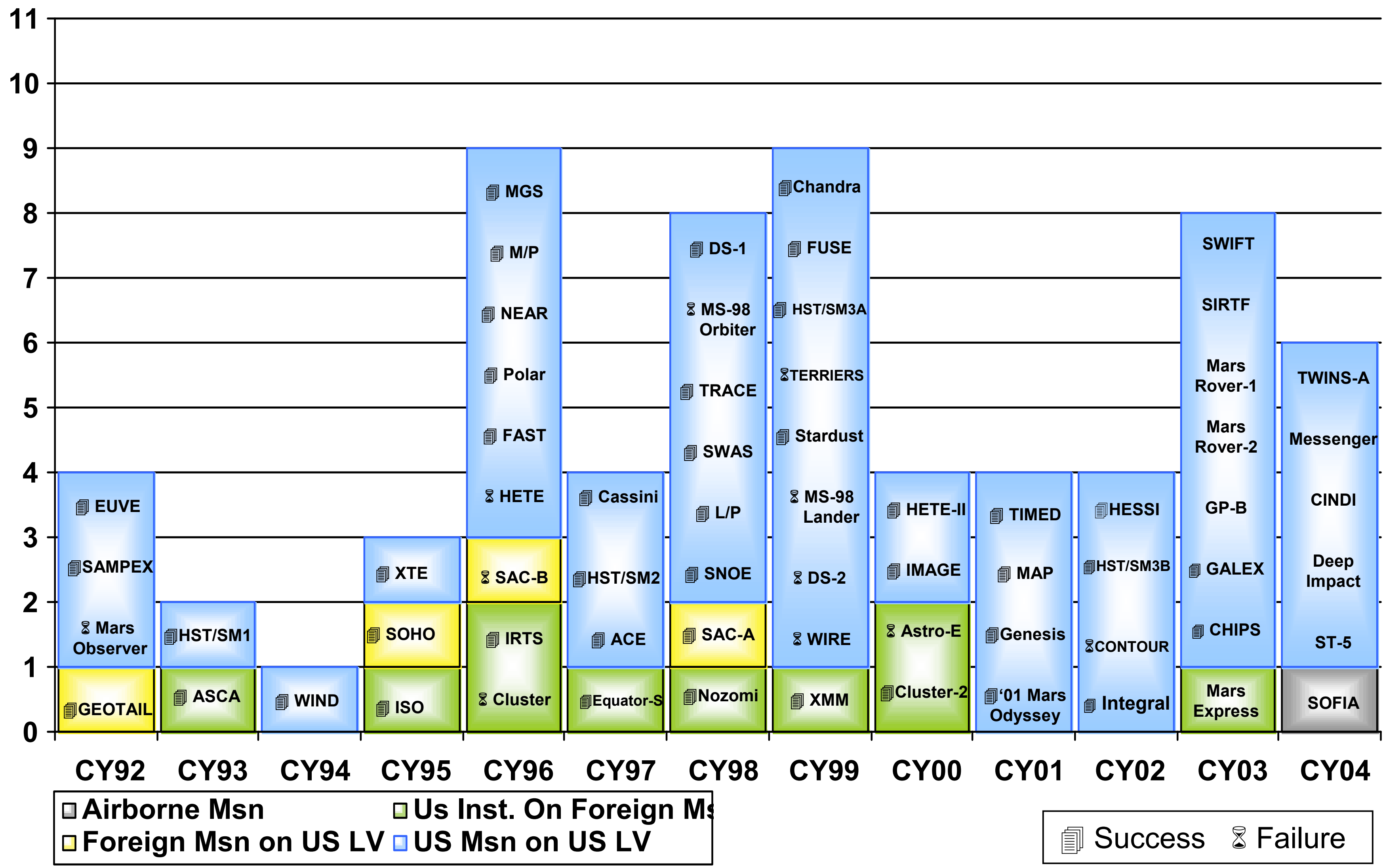


2003 Space Science Launches

- CHIPSat - Launched from VAFB January 12
- GALEX - Launched from CCAFS April 28
- Mars Exploration Rover A - Scheduled from CCAFS NET June 8
- Mars Exploration Rover B - Scheduled from CCAFS June 25
- SIRTF - Scheduled from CCAFS NET August 27
- Gravity Probe B - Scheduled from VAFB NET November 20*
- SWIFT - Scheduled from CCAFS December 5
- CINDI - Scheduled from KWAJ January 23, 2004

*currently under review

Space Science Launches (CY93-CY04)



Upcoming Launch
SIRTF

Launch:

NET August 27, 2003
Cape Canaveral, FL.

Launch Vehicle:

Delta II Heavy

Primary Science Objective:

SIRTF will obtain images and spectra by detecting the infrared energy, or heat, radiated by objects in space.

Most infrared radiation is blocked by the Earth's atmosphere and cannot be observed from the ground.

Upcoming Launches
Mars Exploration Rovers

Launches:

MER A: NET June 8, 2003

MER B: June 25, 2003

Cape Canaveral, FL.

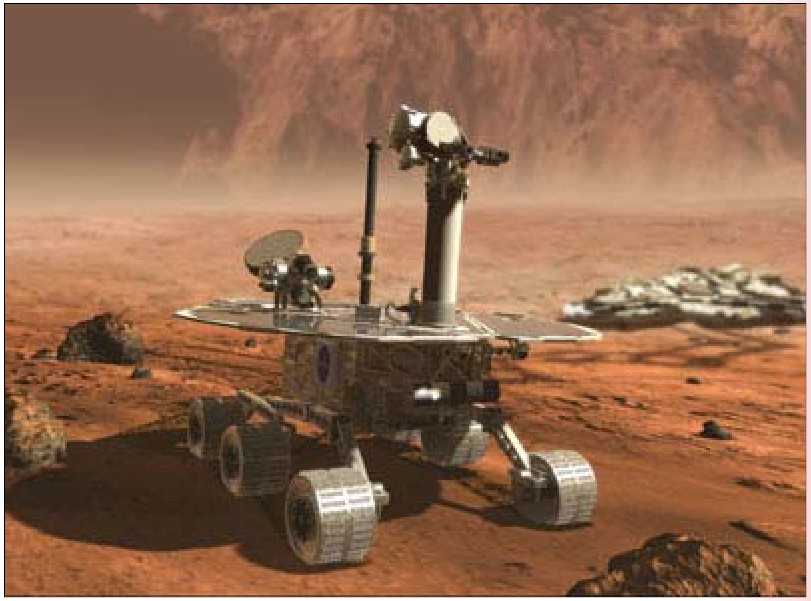
Launch vehicles:

Delta II

Primary Science Objective:

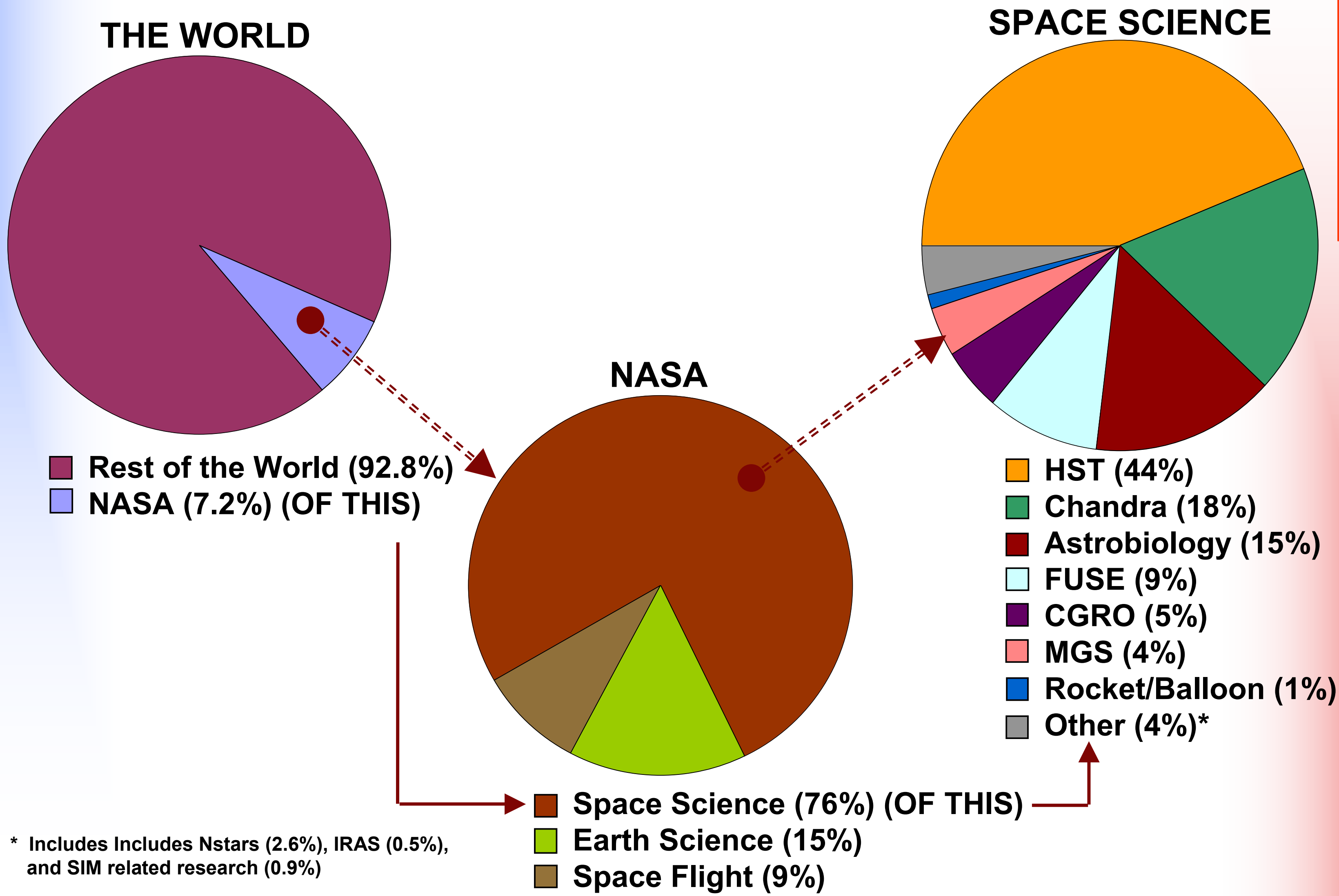
Looking for Signs of Past Water on Mars.

The big science question for the Mars Exploration Rovers is how past water activity on Mars has influenced the red planet's environment over time.



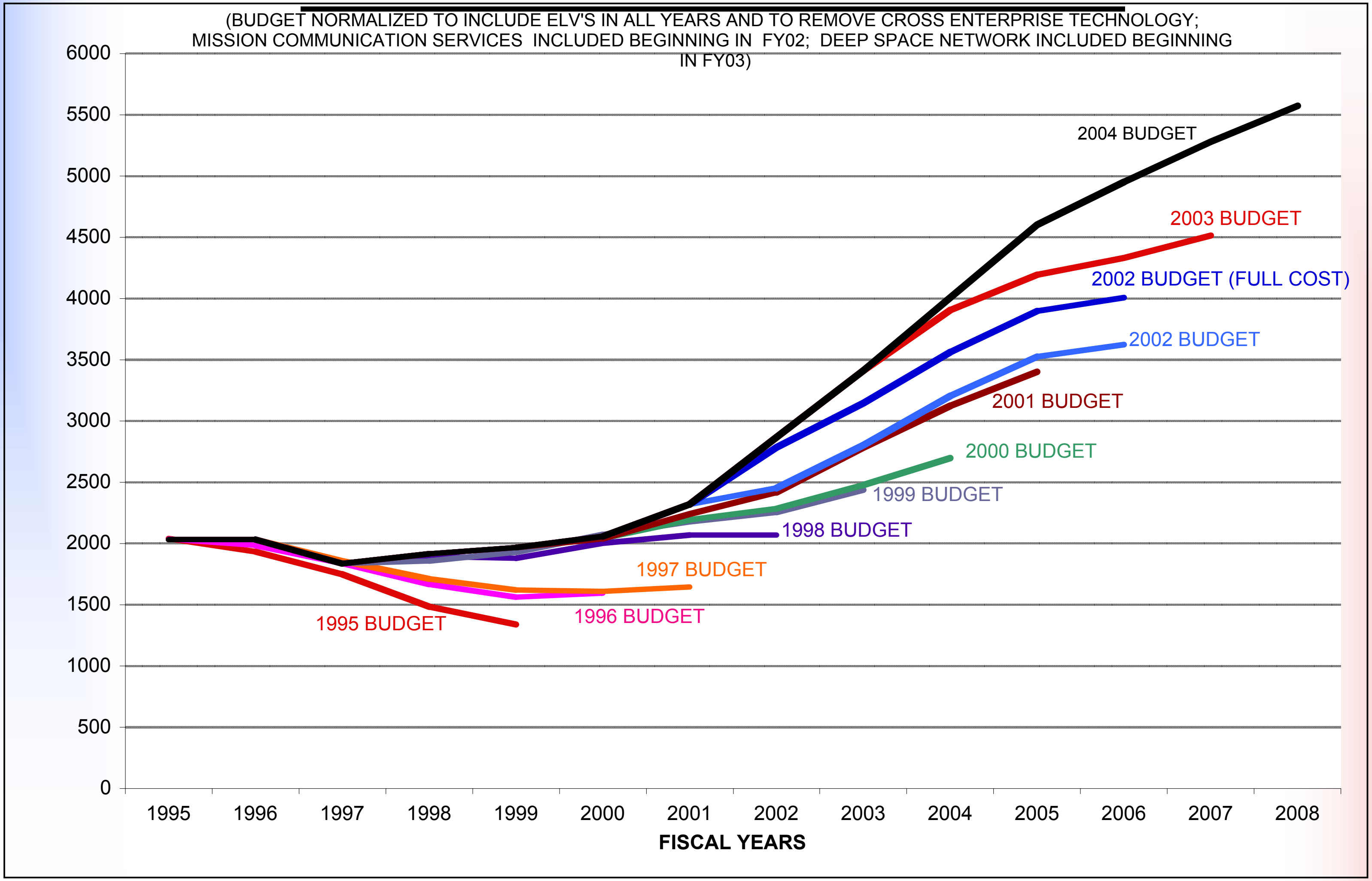
2002 Science News Metrics

Contributions to World Discoveries and Technological Achievements

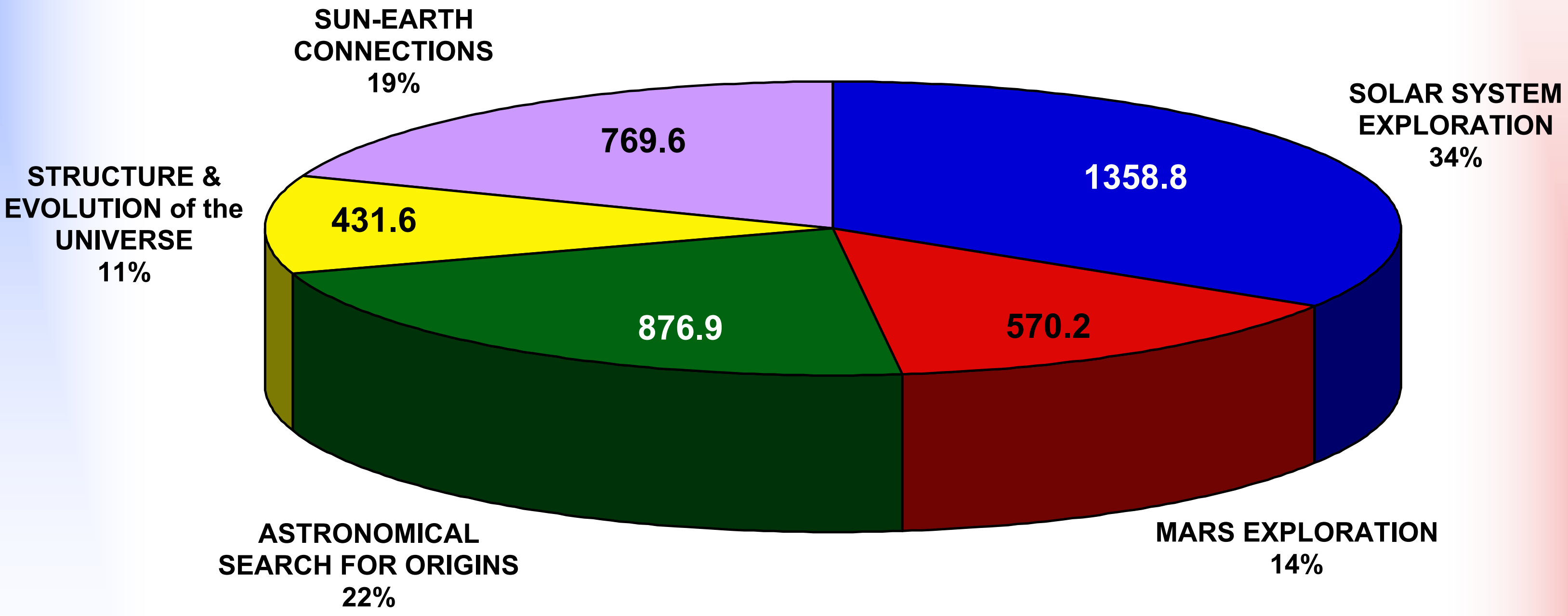


* Includes Includes Nstars (2.6%), IRAS (0.5%), and SIM related research (0.9%)

Space Science Budget History



Space Science Budget
Full-Cost FY04 President's Request



Space Science Budget
FY 2004 New Content

- Incorporates the existing NSI program and the new Jupiter Icy Moons Orbiter (JIMO) mission into a new initiative called Project Prometheus.
- Establishes an Optical Communications program, which enables revolutionary new data communications/transmission.
- Provides development funding for three key elements of the Beyond Einstein program: Constellation X, LISA and Einstein Probes.

Supports increased activity in priority programs

Project Prometheus

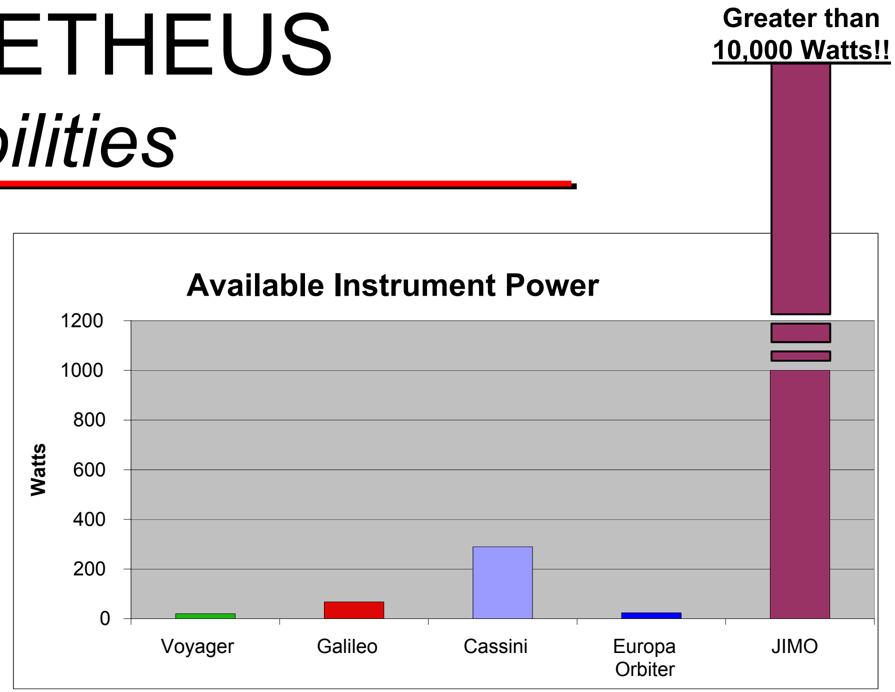
- Project Prometheus will enable vastly more robust and ambitious scientific missions by utilizing future spacecraft nuclear power capabilities.

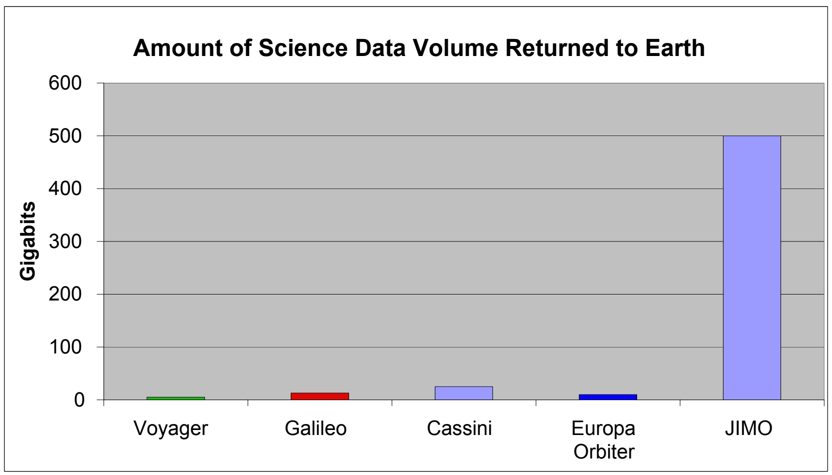
- Nuclear power will:
  - Support more complex scientific instruments
  - Enable significantly larger and faster data communications networks
  - Allow a single spacecraft to visit multiple targets per mission
  - Eliminate dependence on gravity assists

- Project Prometheus includes:
  - The Nuclear Systems Initiative announced with the President's FY03 budget request
  - The Jupiter Icy Moons Orbiter (JIMO) mission, which is the first application of these technologies assigned to a flight mission.

PROJECT PROMETHEUS
Revolutionary Capabilities

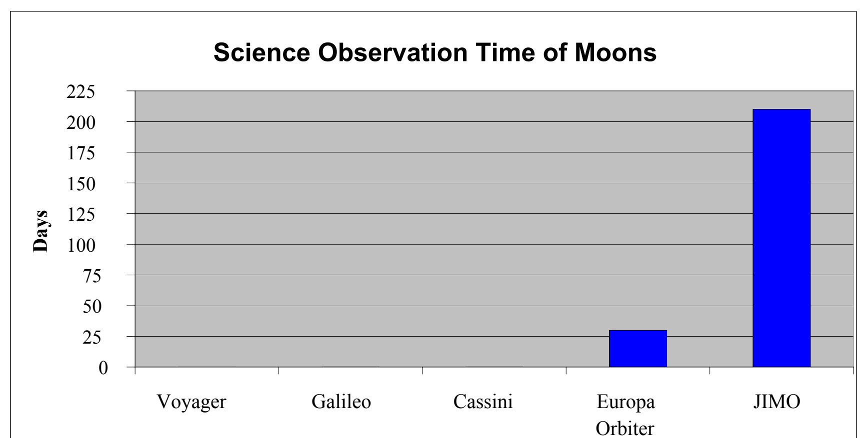
Amount of **power** available to science instruments
One bedside reading lamp compared to a stadium light





Amount of science **data** return
1 – 2 floppy disks as compared to 120 CD-ROMs

Time available for science observation of moons
1 to 5 hours compared to 180 days



Project Prometheus
Jupiter Icy Moons Orbiter (JIMO)

- This mission responds to the National Academy of Sciences' recommendation that a Europa orbiter mission be the number one priority for a flagship mission in Solar System exploration.

- JIMO will search for evidence of global subsurface oceans on Jupiter's three icy moons: Europa, Ganymede, and Callisto.

- JIMO will be the first flight mission to use nuclear power and propulsion technologies.

Artist's concept

- This mission will set the stage for the next phase of exploring Jupiter and will open the rest of the outer Solar System to detailed exploration.

Optical Communications

- Optical communications offers the potential for many orders of magnitude of improvement in communication data rate.

- Will allow for the return of the much greater quantities of scientific data.
  - Enabled by nuclear missions such as Project Prometheus (tours of multiple targets; extended orbital and surface stay times; high-power science instruments).

- Use of optical/laser communication technology will lower the cost per byte of data returned).

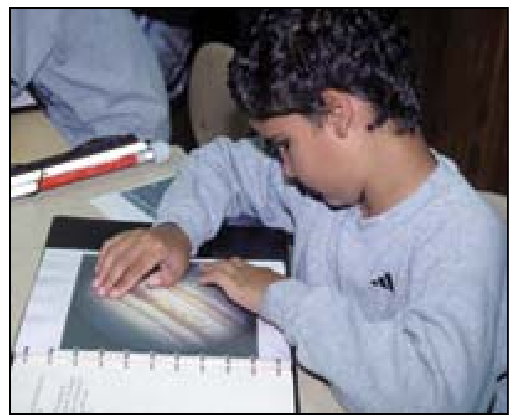
Example of Optical Communications

- The high-resolution camera on MRO will image < 0.1% of the planet after 1 Mars year due to limitations of the communication link back to Earth: ~2.2 Mbps at closest range and 0.3 Mbps at max range (2.7 AU).
- Were it available, optical communication would have the potential to increase the MRO communications link back to Earth to ~ 10Mbps at closest range and 1Mbps at maximum range. This improved high data rate allows one order of magnitude improvement in the time required to complete global high-resolution imaging of Mars. A 6 M pixel image of the entire surface of Mars could be achieved in 4 months!
- Data return from <u>outer planets</u> has the potential to be improved by an order of magnitude or better.

Education and Public Outreach
Getting Results

Voyage: A Scale Model Solar System on the National Capitol Mall

Share the excitement with the public . . .



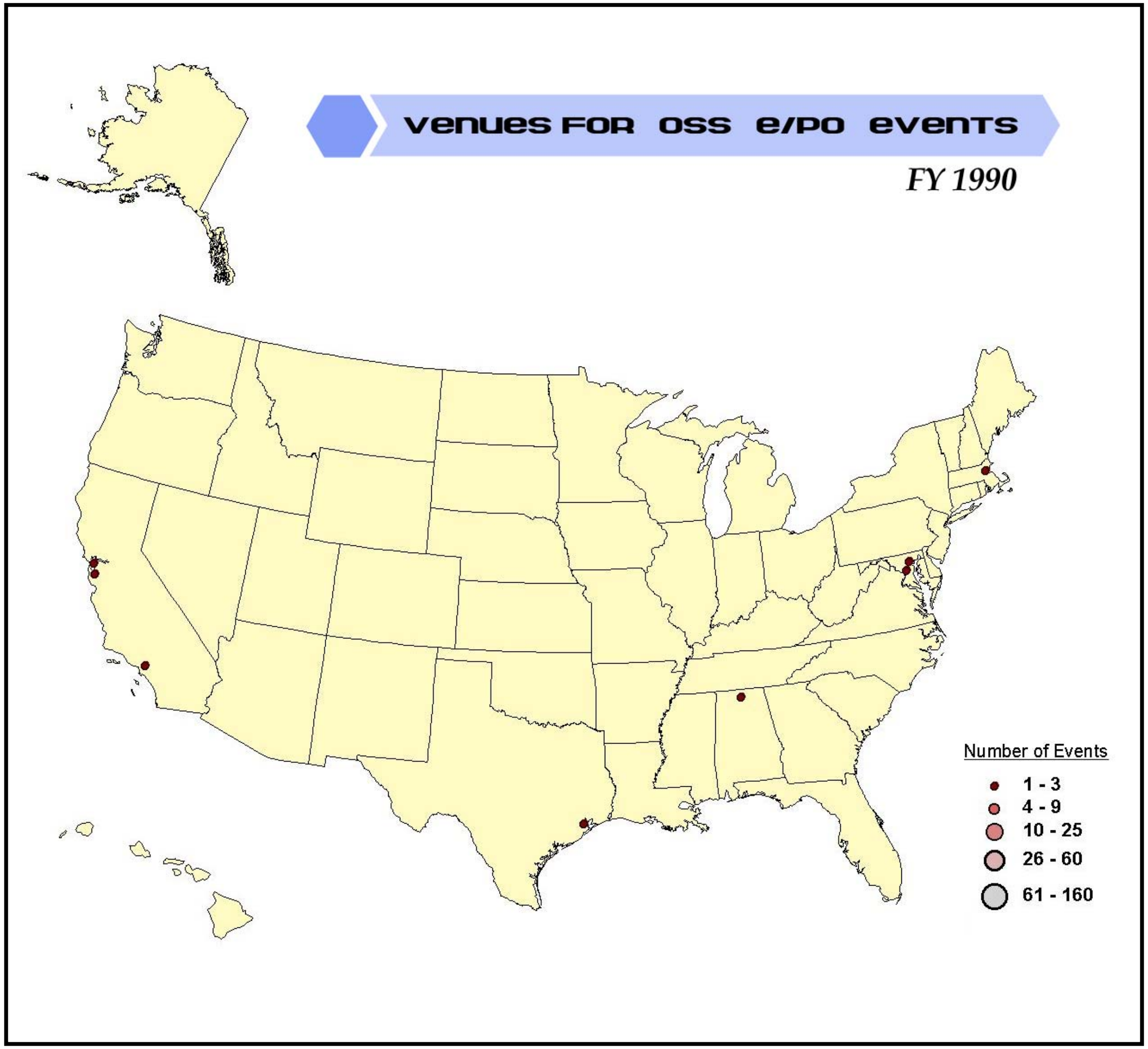
Enhance the quality of education . . .

A Braille book of astronomy

. . . Help create the 21st century workforce.

Space Science Bachelor’s Degree Program at CUNY

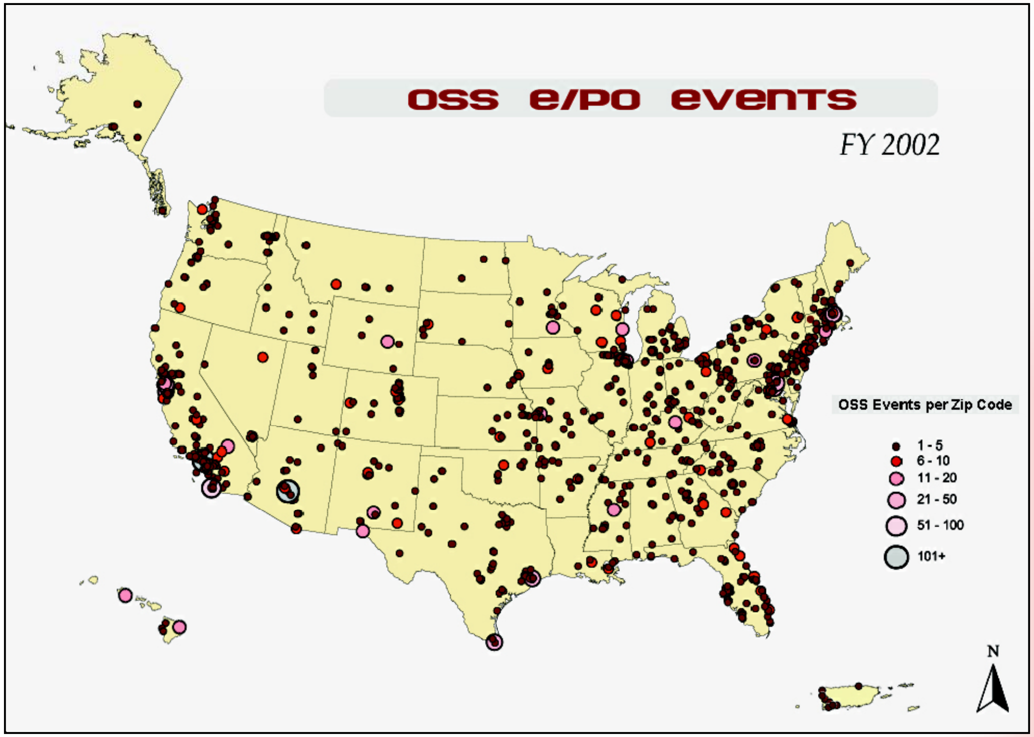
SSE Education/Outreach in 1990



OSS E/PO Program:
. . . And Where We Were in 2002

Overview

- 330 E/PO activities and 70 new products
- More than 3,600 discrete E/PO events
- Presence in all 50 states, DC, and PR
- Presence at 22 national and 30 regional E/PO conferences
- More than 30 awards and other forms of public recognition received

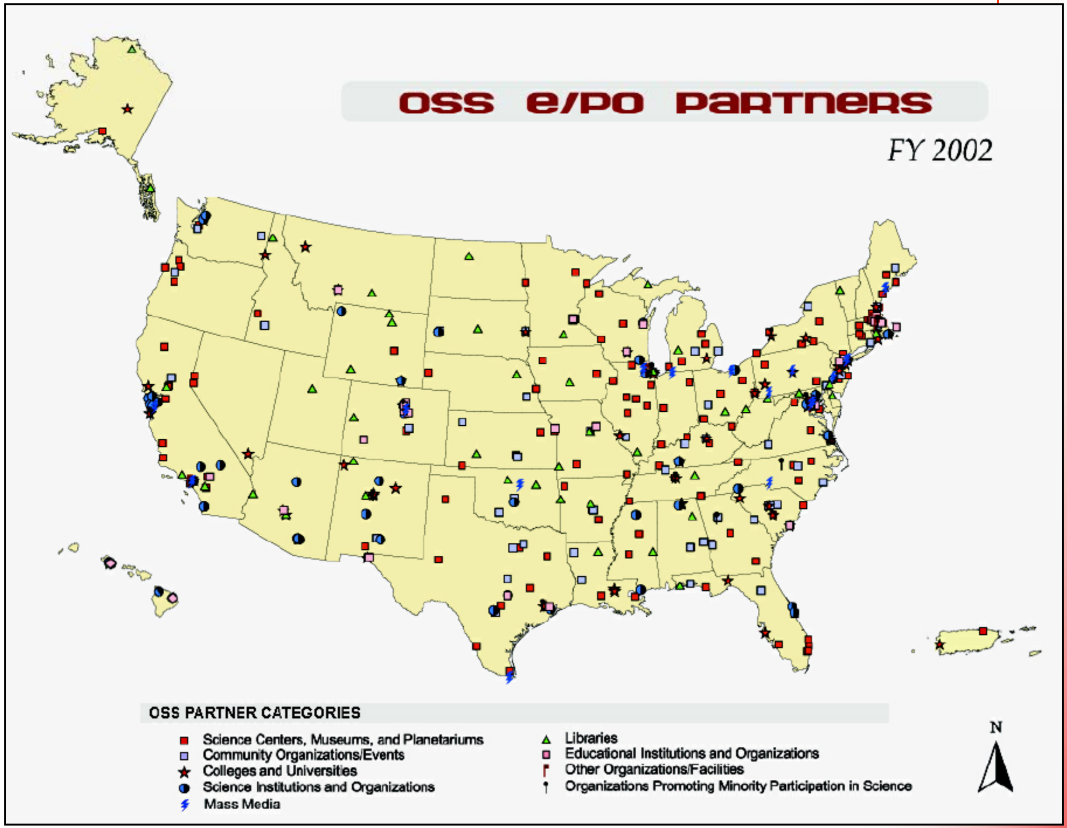


Estimated participants:

- Over 350,000 direct participants in workshops, community/school visits, and other interactive special events.
- Over 1.7 million visitors for museum exhibitions, planetarium shows, public lectures, and special events.
- Over 7 million Internet participants for web casts, web chats, and other web events.
- Accessible to 200 million through conference exhibits, radio and television broadcasts, newspaper columns, and other forms of public media.

Contributors to FY 2002 OSS E/PO Program

- Over 100 OSS Missions and Programs
- Over 1,000 OSS-affiliated scientists, technologists, and support staff
- Over 500 institutional partners, including:
- 150 science centers, museums, planetaria.
- 20 pre-college educational organizations, school districts and boards.
- 175 science institutions and organizations, colleges and universities (including 29 minority institutions).



- 12 professional societies of minority scientists and organizations promoting minority participation in science.
- 120 libraries and community organizations.

OSS Education and Outreach
SScAC E/PO Task Force Membership

Paul Knappenberger, Adler Planetarium	Chair
Jeffrey Rosendhal, NASA Headquarters	Executive Secretary

Sandra Begay-Campbell, Sandia National Laboratory
Andrew Fraknoi, Foothill College & ASP
Heidi Hammel, Space Science Institute
Shelley Lee, Wisconsin State Department of Instruction
Molly Macauley, Resources for the Future
Charles McGruder, Western Kentucky University
Wendell Mohling, National Science Teachers Association
George D. Nelson, Western Washington University
R. Bruce Partridge, Haverford College & AAS
Dennis Schatz, Pacific Science Center
Rob Semper, Exploratorium
Sidney Wolff, National Optical Astronomy Observatories

SScAC E/PO Task Force Report

Implementing the Office of Space Science Education/Public Outreach Strategy: A Critical Evaluation at the Six-Year Mark

Accomplishments and Successes

- Direct engagement of OSS missions and the space science research community in education and in contributing to the public understanding of science;
- A rich harvest of educational programs and materials directed towards many types of audiences in diverse communities across the country
- Significant steps towards involving minorities in the mainstream of OSS's scientific, technical, and educational programs and in developing educational materials directed towards audiences that have not previously been served by NASA; an
- Substantial leveraging of resources through collaboration with hundreds of educational institutions and organizations across the country.

The approach that OSS has taken in implementing its E/PO Program provides a model that is unique to NASA, to the government, and to science education in general. The program is already a credit both to the OSS and to all of the very talented people who have been involved in its planning and execution.

SScAC E/PO Task Force Report

Areas for particular attention

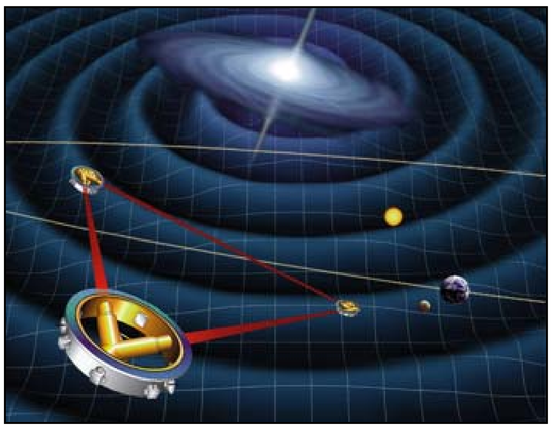
- Make educational products more accessible and organize them in a more coherent way;
- Increase the inclusiveness of the program by involving new audiences, science topics, materials and partnerships;
- Expand and intensify pioneering efforts to attract and better integrate minorities into E/PO projects and into the mainstream of OSS science programs;
- Enhance efforts directed towards quality control and obtaining a better understanding of program impact;
- Increase the effectiveness of the OSS E/PO Support Network by focusing the activities of the Broker/Facilitators on their primary roles;
- Strengthen and expand professional development efforts for E/PO professionals, scientists, and the education community;
- Enhance internal and external communications; and
- Identify and acquire critical resources required for long-term sustainability.

The OSS E/PO program, with its established productive partnership between the space science and education communities and its use of a national network to identify and sustain high-leverage opportunities, has made remarkable progress in a relatively short period of time. Based on its successes to date and the prospects for even greater successes in the future, the approach that has been taken could well serve as a guide for future NASA educational efforts across the Agency.

Beyond Einstein

- Significant expansion of efforts in NASA's Structure and Evolution of the Universe (SEU) theme, addressing its highest priorities as determined by the National Academy of Sciences' Decadal Survey.

- Funding for full development of two major missions: LISA and Constellation-X.



- Funding to initiate "Einstein Probes," a program that will begin later this decade.
  - this program consists of fully and openly competed missions (in the manner of the Discovery, Explorers, and New Frontiers programs) to conduct investigations that benefit the Beyond Einstein science objectives.